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## Disclaimer

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## Welcome "Who's in the Room?"




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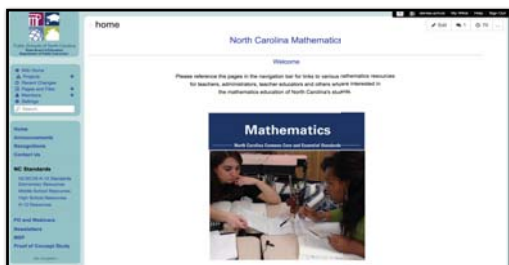
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[maccss.ncdpi.wikispaces.net](http://maccss.ncdpi.wikispaces.net)



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## Research



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We've had a tendency in our traditional scope and sequence of math that you teach all this **whole-number** stuff...and then, all of a sudden, you get to **fractions**, and it's a whole new world of what to do—everything they learned in whole numbers has nothing to do with how you do fractions.

Linda Gojak

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High school students' knowledge of fractions correlates strongly with their overall mathematics achievement in both the UK and the USA. **Fifth graders' fraction knowledge predicts their mastery of algebra and overall mathematics achievement in high school**, even after controlling for IQ, reading achievement, working memory, family income and education, and whole number knowledge.

Siegler, Fazio, Bailey, and Zhou

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Fractions are a rich part of mathematics, but we tend to **manipulate fractions by rote rather than try to make sense of the concepts and procedures**.

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Fractions are a rich part of mathematics, but we tend to **manipulate fractions by rote rather than try to make sense of the concepts and procedures**. Researchers have concluded that this complex topic causes **more trouble for students than any other area of mathematics**.

Bezuk and Bieck 1993

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A representative sample of 1000 US algebra teachers ranked **lack of fraction understanding** as one of the two largest problems hindering their students' algebra learning (trailing only 'word problems', many of which involve fractions).

Siegler, Fazio, Bailey, and Zhou

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Algebra proficiency is more closely related to conceptual knowledge of fractions than to conceptual knowledge of whole numbers.

Siegler, Fazio, Bailey, and Zhou



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## Part-Whole Relationship

- Partitioning wholes into equal-size pieces
- Identifying different units

This is the best way to approach learning about fractions in the early grades. It is essential for students to be provided opportunity to reason about the meaning of part-whole relations.

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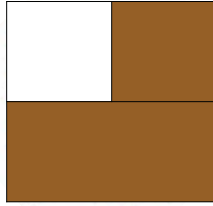
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How much of this brownie has been eaten?



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### What does that tell us?

- Children have some conceptually sound understanding of fractions, even before instruction.
- Children can learn to ignore conceptual understanding in favor of models introduced in school that portray fractions in narrow ways.

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The typical American approach to teaching fractions can overemphasize procedures at the expense of an understanding of the **relationships among numbers**, which is needed for higher math.

Lynn Fuchs

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# Partitioning

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**First Grade**  
**1.G.3 Partition circles and rectangles into two and four equal shares**, describe the shares using the words *halves*, *fourths*, and *quarters*, and use the phrases *half of*, *fourth of*, and *quarter of*. Describe the whole as **two of**, or **four of** the shares. Understand for these examples that **decomposing** into more equal shares creates smaller shares.

**Second Grade**  
**2.G.3 Partition circles and rectangles into two, three, or four equal shares**, describe the shares using the words *halves*, *thirds*, *half of*, *a third of*, etc., and describe the whole as **two halves**, **three thirds**, **four fourths**. Recognize that equal shares of identical wholes need not have the same shape.

**Third Grade**  
**3.G.2 Partition shapes into parts with equal areas**. Express the area of each part as a **unit fraction** of the whole.

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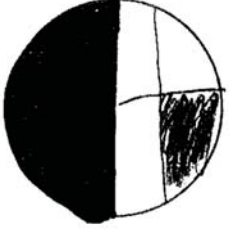
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## Developing Meaning In Partitions



Extending Children's Mathematics, pg. 5

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## Engage in Mathematics

- Participants will engage in tasks to develop conceptual understanding of partitioning.
- Tasks are selected from K-2 Math Assessments and the NCDPI Formative Instructional and Assessment Tasks.

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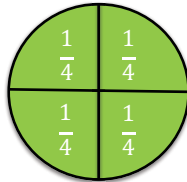
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## Reason with shapes and their attributes.

**3.G.2** Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole.

*For example, partition a shape into 4 parts with equal area, and describe the area of each part as  $\frac{1}{4}$  of the area of the shape.*



3rd Grade

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## How does the study of partitioning in K-3 lead to an understanding of fractions?


### Develop understanding of fractions as numbers.

**3.NF.1** Understand a fraction  $1/b$  as the quantity formed by 1 part when a whole is partitioned into  $b$  equal parts; understand a fraction  $a/b$  as the quantity formed by  $a$  parts of size  $1/b$ .

**3.NF.2** Understand a fraction as a number on the **number line**; represent fractions on a number line diagram.

- Represent a fraction  $1/b$  on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into  $b$  equal parts. Recognize that each part has size  $1/b$  and that the endpoint of the part based at 0 locates the number  $1/b$  on the number line.
- Represent a fraction  $a/b$  on a number line diagram by marking off  $a$  lengths  $1/b$  from 0. Recognize that the resulting interval has size  $a/b$  and that its endpoint locates the number  $a/b$  on the number line.

Grade 3 expectations in this domain are limited to fraction with denominators 2, 3, 4, 6, and 8.

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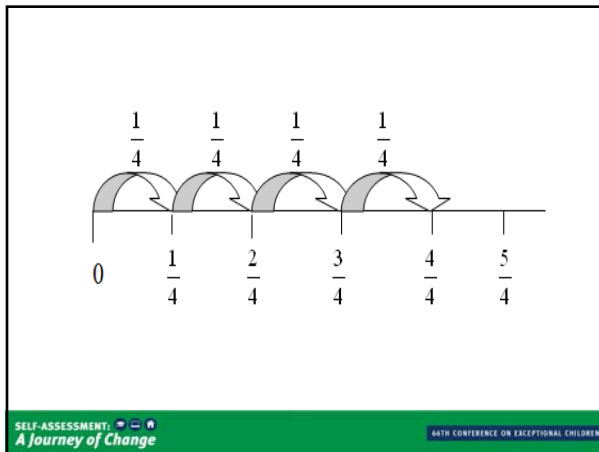
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## Partitioning

- Students need to build an understanding of partitioning and how the pieces relate to the whole.
- Developing an understanding of partitioning helps students develop an understanding of unit fractions which will help with decomposing fractions
- There may be multiple ways to partition, and developing this skill helps building fluency with fractions.

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## Adding with Fractions

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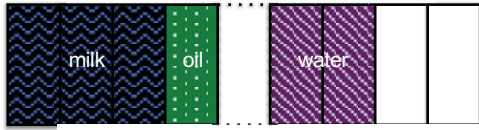
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## Adding Fractions

A cake recipe calls for you to use  $\frac{3}{4}$  cup of milk,  $\frac{1}{4}$  cup of oil, and  $\frac{2}{4}$  cup of water. How much liquid was needed to make the cake?



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## Engage in Mathematics

- Participants will engage in tasks to develop conceptual understanding of adding fractions.
- Tasks are selected from the NCDPI Formative Instructional and Assessment Tasks.

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## Multiplication with Fractions

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## Engage in Mathematics

- Participants will engage in tasks to develop conceptual understanding of multiplying fractions.
- Tasks are selected from the NCDPI Formative Instructional and Assessment Tasks.

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## Putting Multiplication in Context

- With a partner, create a problem that illustrates each of the following:
  - Multiplication of a fraction  $\times$  whole number
  - Multiplication of a whole number  $\times$  fraction
- Exchange problems with another partner group and write equations to match the written problems.

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## What does it mean to divide by a fraction?

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## Engage in Mathematics

- Participants will engage in tasks to develop conceptual understanding of dividing with fractions.
- Tasks are selected from the NCDPI Formative Instructional and Assessment Tasks.

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## Putting Division in Context

- With a partner, create a problem that illustrates each of the following:
  - Division of whole number by a fraction
  - Division of a fraction by a whole number
- Exchange problems with another partner group and write equations to match the written problems.

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## Maintain the Value of the Quotient

- Invert and multiply vs. developing the concept of the procedure
- Learning the algorithm does not mean that you understand the mathematics, but understanding the mathematics can help you learn and remember the algorithm.

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## Turn & Talk

- How does the concept of fractions develop across K-5?
- Why is it important for students to have conceptual understanding of fractions before entering middle school?

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## What questions do you have?



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### DPI Mathematics Section

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For all you do for our students!

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